

## CANADIAN ENTITLEMENT DETERMINATION

for

1967-68

This study was made for the purpose of providing an estimate of the Canadian Entitlement to downstream power benefits during 1967-68 based on advancing the initial closure of Duncan by one year.

The Canadian Entitlement computations were based on procedures set out in Annex B of the Treaty and in Articles VIII, IX, and X of the Protocol.

The Canadian Entitlement was computed to be:

Dependable Capacity = 176 mw

Average Annual Energy = 95 mw

The following tables and chart are attached and summarize the study. Where possible, the illustrations are presented in the same format as used in the November 1963 Technical Report of Work Group No. 1, titled "Determination of Canadian Downstream Power Entitlement."

Table 1. Computation of Canadian Entitlement - 1967-68

The essential elements used in the computation of the Canadian Entitlement as provided in Paragraph 2 and 3 of Annex B are shown in this table.

Table 2. Summary of Power Regulations for 1967-68 for the Computation of Canadian Entitlement to Downstream Benefits from Early Closure of the Duncan Project

This table summarizes the Step 1, 2, and 3 regulations by projects. Capability data is the actual capability from the regulation studies and do not reflect adjustments for encroachment.

Table 3. Determination of Load Shape for Steps 2 and 3, 1967-68 Canadian Entitlement Computation

The load shape for Steps 2 and 3 carry the same ratio between each month and the annual average as does the Pacific Northwest area load. The Northwest area firm loads on this table were based on the current West Group Forecast data, adjusted to include Idaho Power Company, Montana Power Company west of the Continental Divide, and a small increase in the BPA firm load. The Grand Coulee pumping load is also included in this estimate.

The firm load for Steps 2 and 3 is computed as follows:

- (1) Estimate the hydro prime power;
- (2) Add the thermal from Step 1 less reserve;
- (3) Multiply (2) by the ratio of the area annual average firm load to the area critical period firm load to obtain the annual average firm load for Steps 2 or 3 (the ratio used in this study was 0.9658);
- (4) Pro rate the average annual determined in (3) by months in the ratio that each monthly area load bears to the annual average area load; and
- (5) Subtract the thermal in each month to obtain the monthly firm hydro load. The average annual hydro load for Steps 2 and 3 also becomes the firm energy considered usable according to Annex B, Paragraph 3(a).

Table 4. Estimated Distribution of Canadian Average Annual Energy Entitlement

The 190 mw gain in average annual usable energy was allocated to each base system project in proportion to its average annual gain. One-half of this allocation is the Canadian Energy Entitlement from the project.

Table 5. Estimated Distribution of Canadian Dependable Capacity Entitlement

The Canadian dependable capacity entitlement of 176 mw was allocated to each base system project in proportion to its gain in prime power.

Table 6. Adjustment for Estimated Encroachment -- Mid-Columbia Projects, 1967-68 Prime Power and Average Annual Energy

This table shows the encroachment adjustments which were applied to the Mid-Columbia project energy capabilities prior to making the allocation of Canadian Entitlement. The encroachment computations were based on data currently being used for Coordination Agreement purposes with the exception of Wells and Chief Joseph. The encroachment for these projects was based on data derived from recent tests at Chief Joseph to simulate operation with and without Wells.

Chart 1. Secondary Energy Duration Curve, 1967-68, Steps 2 and 3

This chart is a duration curve of the secondary energy for Steps 2 and 3. The secondary energy is the capability each month which exceeds the firm hydro loads shown in Table 3. The usable secondary energy shown in average megawatts for each step is computed in accordance with Annex B, Paragraphs 3 (b) and 3 (c). The "other usable secondary" was computed on the basis of 40% of the remainder after thermal replacement. The thermal replacement was limited to the existing conventional thermal energy capability after allowance for reserve (433-22=411 mw) since the NPR was assumed to be on dual purpose operation and not replaceable.

The following tabulation shows the ordinate values for usable secondary energy:

	<u>Step 2</u>	<u>Step 3</u>
Thermal replacement	411	411
Other	<u>1,070</u>	<u>1,120</u>
Total - mw	1,481	1,531

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## COMPUTATION OF CANADIAN ENTITLEMENT

1967-68

Generation Figures are in Average Megawatts; Load Factors, in Percent

Determination of Dependable Capacity Credited to Canadian Storage

Critical Period Average Rate of Generation with Canadian Storage, Step 2	6,752
Critical Period Average Rate of Generation without Canadian Storage, Step 3	6,495
Gain Due to Canadian Storage . . . . .	257
Estimated Average Critical Period Load Factor -- Percent . . . . .	73.053
Dependable Capacity Gain $\frac{1}{\text{L}}$ . . . . .	352
Canadian Share of Dependable Capacity . . . . .	176

Determination of Increase in Average Annual Usable EnergyStep 2 (with Canadian Storage)

Annual Firm Hydro Energy . . . . .	6,487
Thermal Replacement Energy . . . . .	341
Other Usable Secondary Energy . . . . .	763
System Annual Average Usable Energy . . . . .	7,591

Step 3 (without Canadian Storage)

Annual Firm Hydro Energy . . . . .	6,238
Thermal Replacement Energy . . . . .	347
Other Usable Secondary Energy . . . . .	816
System Annual Average Usable Energy . . . . .	7,401

Average Annual Usable Energy Gain . . . . .	190
Canadian Share of Average Annual Energy Gain . . . . .	95

$\frac{1}{\text{L}}$  Dependable capacity gain credited to Canadian storage equals gain in critical period average rate of generation divided by the estimated average critical period load factor.

TABLE 2

SUMMARY OF POWER REGULATIONS FOR 1967-68  
FOR THE  
COMPUTATION OF CANADIAN ENTITLEMENT  
TO DOWNSTREAM BENEFITS FROM  
EARLY CLOSURE OF THE DUNCAN PROJECT

PROJECTS	BASIC DATA		STEP 1			STEP 2				STEP 3			
	Number of Units	Nominal Installed Peaking Capacity MW	Useable Storage 1000 AF	January Peaking Capability MW	Critical Period Average Generation MW	Useable Storage 1000 AF	January Peaking Capability MW	Critical Period Average Generation MW	Average Annual Generation MW	Useable Storage 1000 AF	January Peaking Capability MW	Critical Period Average Generation MW	Average Annual Generation MW
<b>CANADIAN</b>													
Duncan			1,402			1,402							
<b>BASE SYSTEM FEDERAL</b>													
Hungry Horse	4	328	3,161	271	208	3,008	278	212	100	3,008	278	212	100
Albion Falls	3	49	1,155	23	25	1,155	23	25	24	1,155	23	25	24
Grand Coulee	18+2	2,294	5,232	2,111	1,425	5,072	2,119	1,366	1,786	5,072	2,134	1,292	1,747
Chief Joseph	16	1,280		1,280	742		1,280	716	995		1,280	675	976
Lee Harbor	3	310		310	167		310	169	231		310	169	231
McMurry	14	1,127		1,127	589		1,127	578	841		1,127	558	834
John Day	0 - 3	-		-	-		-	-	-		-	-	-
The Dalles	14	1,286		1,286	624		1,286	609	908		1,286	588	900
Bonneville	10	558		558	437		558	429	508		558	416	504
Subtotal		7,232	9,548	8,968	4,217	9,235	8,981	4,104	5,431	9,235	8,996	3,935	5,354
<b>BASE SYSTEM NON-FEDERAL</b>													
Kootenay Lake (Canadian)			817			673				673			
Kerr	3	184	1,219	179	147	1,219	179	151	123	1,219	179	151	123
Thompson Falls	6	40		39	37		39	38	33		39	38	33
Horton Rapids	4	430	231	419	174		430	178	220		430	178	220
Cabinet Gorge	4	230		230	112		230	111	131		230	111	131
Box Canyon	4	79		79	60		79	61	57		79	61	57
Coeur d'Alene Lake and Long Lake			327			223				223			
Wells	0 - 9	618		618	321		618	310	362		618	293	354
Chelan	2	51	677	52	47	676	52	49	43	676	52	49	43
Rocky Reach	7	815		815	465		815	451	616		815	426	606
Rock Island	10	159		159	136		159	132	143		159	126	141
Manapua	10	986		986	403		986	390	599		986	369	591
Priest Rapids	10	912		912	391		912	379	565		912	360	558
Brownlee	4	450	980	450	267	974	450	269	285	974	450	269	285
Oxbow	4	219		219	127		219	129	133		219	129	133
Subtotal		5,176	4,251	5,157	2,687	3,765	5,168	2,648	3,310	3,765	5,168	2,560	3,275
<b>TOTAL BASE SYSTEM HYDRO</b>		12,408	15,201	12,123	6,904	14,402	12,149	6,752	8,741	13,000	12,164	6,495	8,629
<b>ADDITIONAL STEP 1 PROJECTS</b>													
Boundary	0 - 4	632		632	362								
Hells Canyon	0 - 3	142		142	136								
Spokane River Plants		153		149	85								
Fallon and Round Butte		424	274	398	146								
Subtotal		1,351	274	1,321	729								
<b>TOTAL HYDRO RESOURCES</b>		13,759	15,475	13,444	7,633								
<b>THERMAL RESOURCES 1/</b>				1,339	1,015			1,015 3/				1,015 2/	
<b>TOTAL RESOURCES (HYDRO AND THERMAL)</b>				14,783	8,648								
<b>RESERVES 2/</b>				1,208	22								
<b>RESOURCES AVAILABLE FOR LOAD</b>				13,575	8,626								
<b>ESTIMATED LOAD</b>													
Pacific Northwest Area				14,929	9,957								
Less Independent Resources				3,550	1,665								
Subtotal				11,379	8,292								
Plus Canadian Entitlement				176	95								
<b>SYSTEM LOAD</b>				11,555	8,387								
<b>SURPLUS OR DEFICIT</b>				2,020	239								
<b>CRITICAL PERIOD:</b>													
Starts				September 1936			September 16, 1936				September 16, 1936		
Ends				April 15, 1937			April 15, 1937				April 15, 1937		
Length (Months):				7 1/2 Months			7 Months				7 Months		
<b>STUDY IDENTIFICATION</b>				68-1			68-2				68-3		

1/ Includes 786 mw peak and 582 mw energy from NPR under dual purpose operation, 466 mw peak and 391 mw energy from existing thermal plants and 87 mw peak and 42 mw energy from miscellaneous contracts. The NPR figures reflect an adjustment for reserve requirements.

2/ Peak reserves are 8% of peak load; energy reserves are 5% of the net thermal capability after deducting NPR.

3/ Thermal replacement in Steps 2 and 3 was limited to 411 mw, which is the total conventional thermal less 22 mw reserve.

Determination of Load Shape for Steps 2 and 3  
1967-68 Canadian Entitlement Computation

Pacific Northwest Area Load				Step 2			Step 3		
	Peak	Avg.	Load Factor Percent	Total Firm Load 1/	Thermal Firm Load 2/	Hydro Firm Load	Total Firm Load 1/	Thermal Firm Load 2/	Hydro Firm Load
July	11,664*	8,867	76.02	6,848	993	5,855	6,621	993	5,628
August	11,802*	8,993	76.20	6,946	993	5,953	6,715	993	5,722
Sept. 1-15	12,047*	8,946	74.26	6,909	993	5,916	6,680	993	5,687
Sept. 16-30	12,047*	8,946	74.26	6,909	993	5,916	6,680	993	5,687
October	12,746*	9,271	72.74	7,160	993	6,167	6,923	993	5,930
November	13,896*	9,954	71.63	7,688	993	6,695	7,433	993	6,440
December	14,451*	10,463	72.40	8,081	993	7,088	7,813	993	6,820
January	14,929*	10,768	72.13	8,316	993	7,323	8,041	993	7,048
February	14,131*	10,447	73.93	8,069	993	7,076	7,801	993	6,808
March	13,560*	10,048	74.10	7,760	993	6,767	7,503	993	6,510
Apr. 1-15	13,005*	9,571	73.59	7,392	993	6,399	7,147	993	6,154
Apr. 16-30	13,005*	9,571	73.59	7,392	993	6,399	7,147	993	6,154
May	12,861*	9,512	73.96	7,346	993	6,353	7,103	993	6,110
June	12,505*	9,422	75.35	7,277	993	6,284	7,036	993	6,043
Crit. Period Avg.		9,957	73.053	7,745	993	6,752	7,488	993	6,495
Annual Average		9,685		7,480	993	6,487	7,232	993	6,239
January Peak	14,929*			11,529*			11,148*		
Step 1 Critical Period Sept. 1936-Apr. 15, 1937 7½-Months				Crit. Per. Sept. 16, 1936 - April 15, 1937 7-Months			Crit. Period Sept. 16, 1936 - April 15, 1937 7-Months		

1/ Total firm load of Step 2 and Step 3 systems, computed for each system to have an average energy load equivalent to the average energy capability within the critical period and to bear a constant ratio, month by month, to the Pacific Northwest Area Load.

2/ Thermal requirement to meet Pacific Northwest Area Load plus the Canadian Entitlement of Step 1.

\* Figures so marked are peak megawatts. All other figures are monthly or semi-monthly energy in average megawatts.

TABLE 4

Estimated Distribution of  
Canadian Average Annual Energy Entitlement  
1967-68

Average Megawatts

Projects	Average Annual Energy			Avg. Ann. Usable Gain Allocation	One-Half Avg. Ann. Usable Gain Allocation
	Step 2	Step 3	Gain		
<u>Federal</u>					
Hungry Horse	100	100	-	-	-
Albeni Falls	24	24	-	-	-
Grand Coulee	1,786	1,747	39	67	34
Chief Joseph <u>1/</u>	1,029	1,009	20	34	17
Ice Harbor	231	231	-	-	-
McNary	841	834	7	12	6
John Day	38	38	-	-	-
The Dalles	908	900	8	14	7
Bonneville	<u>508</u>	<u>504</u>	<u>4</u>	<u>7</u>	<u>3</u>
Total Federal	5,465	5,387	78	134	67
<u>Non-Federal</u>					
Kerr	123	123	-	-	-
Thompson Falls	33	33	-	-	-
Noxon Rapids	220	220	-	-	-
Cabinet Gorge	131	131	-	-	-
Box Canyon	57	57	-	-	-
Wells <u>1/</u>	328	321	7	12	6
Rocky Reach <u>1/</u>	613	603	10	15	7
Rock Island <u>1/</u>	228	226	2	3	2
Wanapum <u>1/</u>	534	526	8	14	7
Priest Rapids <u>1/</u>	545	538	7	12	6
Chelan <u>1/</u>	46	46	-	-	-
Brownlee	285	285	-	-	-
Oxbow	<u>133</u>	<u>133</u>	<u>-</u>	<u>-</u>	<u>-</u>
Total Non-Federal	3,276	3,242	34	56	28
TOTAL	8,741	8,629	112	190	95

1/ Energy capabilities are adjusted for encroachments.

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TABLE 5

Estimated Distribution of  
Canadian Dependable Capacity Entitlement  
1967-68

Megawatts

Projects	Prime Power				Nom. Prime Pwr. Gain Alloc. to Project	One-Half Dependable Capacity Gain Allocation
	Step 2	Step 3	Gain	Loss		
<u>Federal</u>						
Hungry Horse	212	212	-	-	-	-
Albeni Falls	25	25	-	-	-	-
Grand Coulee	1,366	1,292	74	-	74	51
Chief Joseph <u>1/</u>	758	716	42	-	42	29
Ice Harbor	169	169	-	-	-	-
McNary	578	558	20	-	20	14
John Day	-	-	-	-	-	-
The Dalles	609	588	21	-	21	14
Bonneville	<u>429</u>	<u>416</u>	<u>13</u>	-	<u>13</u>	<u>9</u>
Total Federal	4,146	3,976	170	-	170	117
<u>Non-Federal</u>						
Kerr	151	151	-	-	-	-
Thompson Falls	38	38	-	-	-	-
Noxon Rapids	178	178	-	-	-	-
Cabinet Gorge	111	111	-	-	-	-
Box Canyon	61	61	-	-	-	-
Wells <u>1/</u>	268	252	16	-	16	11
Rocky Reach <u>1/</u>	448	423	25	-	25	17
Rock Island <u>1/</u>	221	212	9	-	9	6
Wanapum <u>1/</u>	318	300	18	-	18	12
Priest Rapids <u>1/</u>	362	343	19	-	19	13
Chelan <u>1/</u>	52	52	-	-	-	-
Brownlee	269	269	-	-	-	-
Oxbow	<u>129</u>	<u>129</u>	-	-	-	-
Total Non-Federal	2,606	2,519	87	-	87	59
TOTAL	6,752	6,495	257	-	257	176

1/ Energy capabilities are adjusted for encroachments.

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TABLE 6

Adjustments for Estimated Encroachment -- Mid-Columbia Projects  
1967-68 Prime Power and Average Annual Energy

Average Megawatts

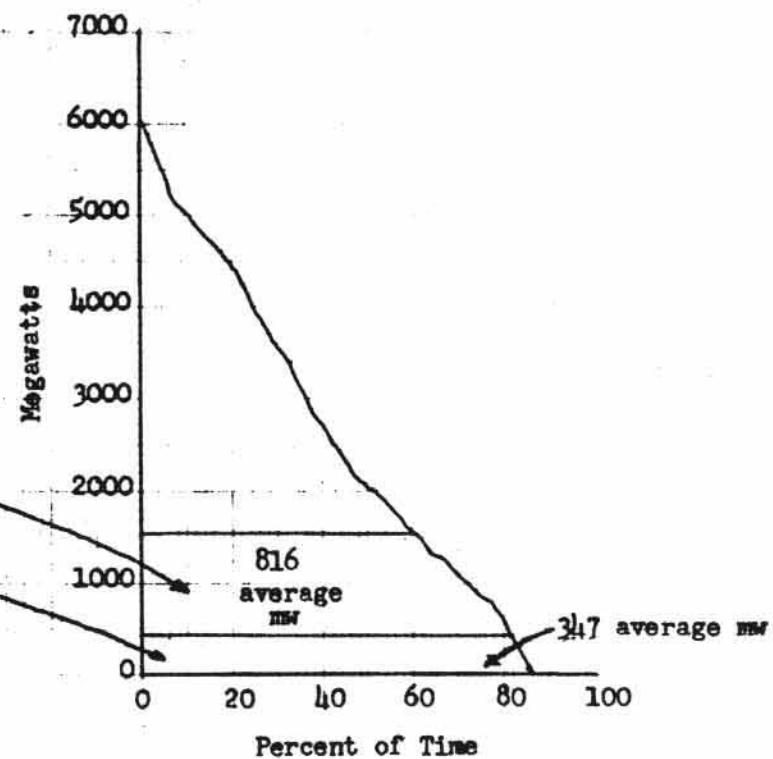
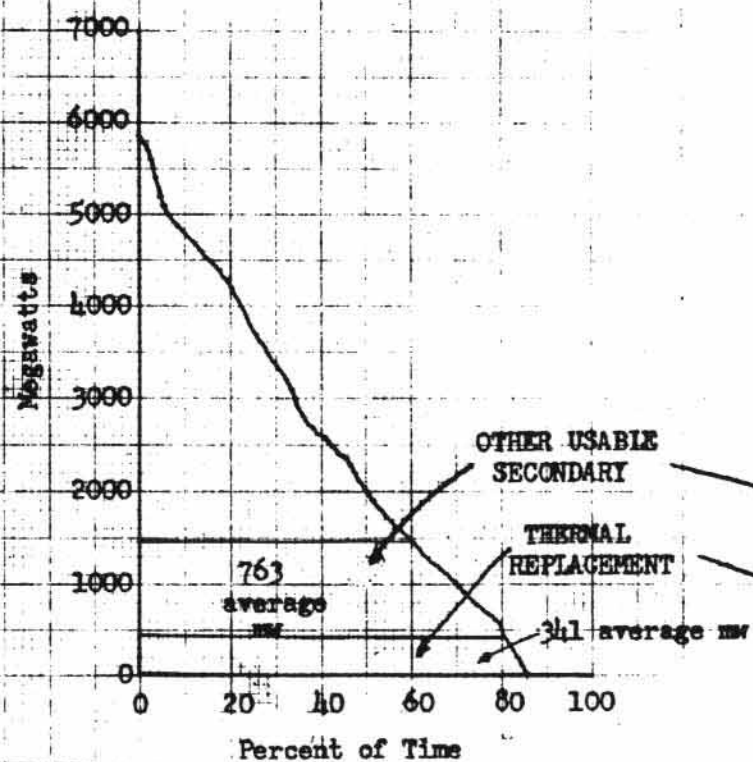
Project	Step 2		Step 3	
	Prime mw	Ann. Avg. mw	Prime mw	Ann. Avg. mw
Chief Joseph	716	995	675	976
Encroachment from Wells	+42	+34	+41	+33
Net	<u>758</u>	<u>1,029</u>	<u>716</u>	<u>1,009</u>
Wells	310	362	293	354
Encroachment on Chief Joe	-42	-34	-41	-33
Net	<u>268</u>	<u>328</u>	<u>252</u>	<u>321</u>
Chelan	49	43	49	43
Encroachment from R. R.	+3	+3	+3	+3
Net	<u>52</u>	<u>46</u>	<u>52</u>	<u>46</u>
Rocky Reach	451	616	426	606
Encroachment on Chelan	-3	-3	-3	-3
Net	<u>448</u>	<u>613</u>	<u>423</u>	<u>603</u>
Rock Island	132	143	126	141
Encroachment from Wanapum	+89	+85	+86	+85
Net	<u>221</u>	<u>228</u>	<u>212</u>	<u>226</u>
Wanapum	390	599	369	591
Encroachment from P.R.	+17	+20	+17	+20
Encroachment on R.I.	-89	-85	-86	-85
Net	<u>318</u>	<u>534</u>	<u>300</u>	<u>526</u>
Priest Rapids	379	565	360	558
Encroachment on Wanapum	-17	-20	-17	-20
Net	<u>362</u>	<u>545</u>	<u>343</u>	<u>538</u>

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# SECONDARY ENERGY DURATION CURVE 1967-68

STEP 2

STEP 3



BPA-BPR Revised 6-21-66